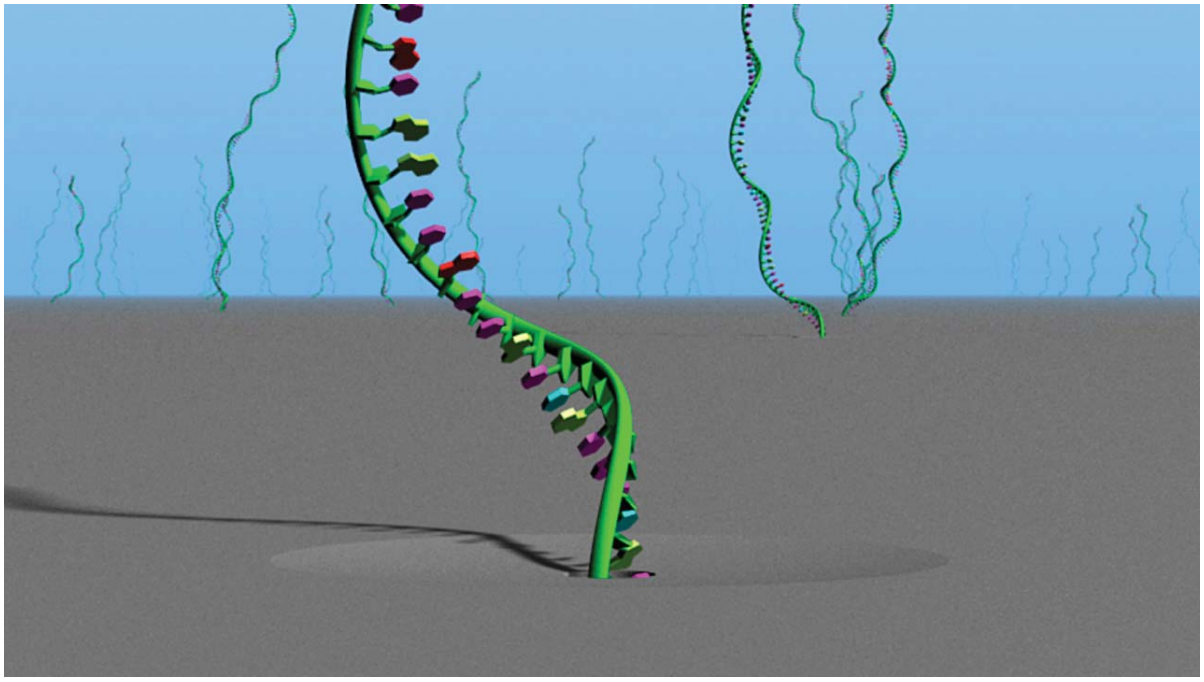
National Aeronautics and Space Administration

technology opportunity

Rapid Polymer Sequencer

A device that can sequence single molecules at a rate of a million bases per second



The NASA Ames Genome Research Facility is developing a solid-state nanopore device with specified geometry and composition of the nanopore.

Solid-state nanopore-based analysis of nucleic acid polymers is revolutionary. No other technique can determine information content in single molecules of genetic material at the speed of 1 subunit per microsecond. Because individual molecules are counted, the output is intrinsically quantitative. The nanopore approach is more generalized than any other method and in principle may be used to analyze any polymer molecule, including proteins. Solid-state nonopore-based analysis of nucleic acid polymers. The approach to the development of a solid-state nanopore device is novel in the use of nanofabrication, nanoelectronic components, and high-speed signal acquisition. A novel geometry of the solid-state nanopore (less than 5 nm in length and 5 nm in diameter) will enable 1-5 nucleotide resolution measurements. This means that maximum resolution will be improved at least 100-fold compared to biological ion-channel measurements. The solid-state nanopore sensor will be made to enable sequencing DNA at a much faster rate than presently possible without the need for extensive sample preparation procedures, such as enzymatic amplification and labeling reactions. It will analyze electronic properties of individual subunits of DNA or RNA, to obtain linear composition of each genetic polymer molecule.

Technology Details

Experimentation resulted in a solid-state nanopore made using nanofabrication techniques. The nanopore channel with a diameter and length of less than 5 nm is made in a silicon-based chip that has nanoelectrodes placed adjacent to the pore. High-speed electronic equipment with exceptional signal acquisition capabilities is used to analyze electronic properties of individual subunits of DNA or RNA, to obtain a linear composition of each genetic polymer molecule. The nanopore sensor is expected to have unmatched speed and sensitivity of DNA detection and sequencing, enabling personalized molecular medicine, revolutionary modification of agriculture and food industry, and decoding of ecosystem-wide genetic variation. The tremendous payoffs of such a nanopore sensor are twofold. Firstly, the complete DNA sequence information underlying the biodiversity of planet Earth will be within reach, thus enabling a complete understanding of the molecular basis of life. Secondly, such a robust sensor would enable the detection of life on other planets by detecting any information-encoding biopolymers, and would also apply to r eal-time, molecular astronaut health monitoring, and pathogen and environment monitoring systems.

Patents

This technology has been patented (U.S. Patent 7,949,472).

Licensing and Partnering Opportunities

This technology is part of NASA's Innovative Partnerships Program, which seeks to transfer technology into and out of NASA to benefit the space program and U.S. industry. NASA invites companies to inquire about the licensing possibilities for the Solid-state Nanopores for Gene Sequencing for commercial applications.

For More Information

If you would like more information about this technology, please contact:

Pam Beato-Day
Technology Partnerships Division
NASA Ames Research Center
(650) 604-2587, pamela.a.beato-day@nasa.gov